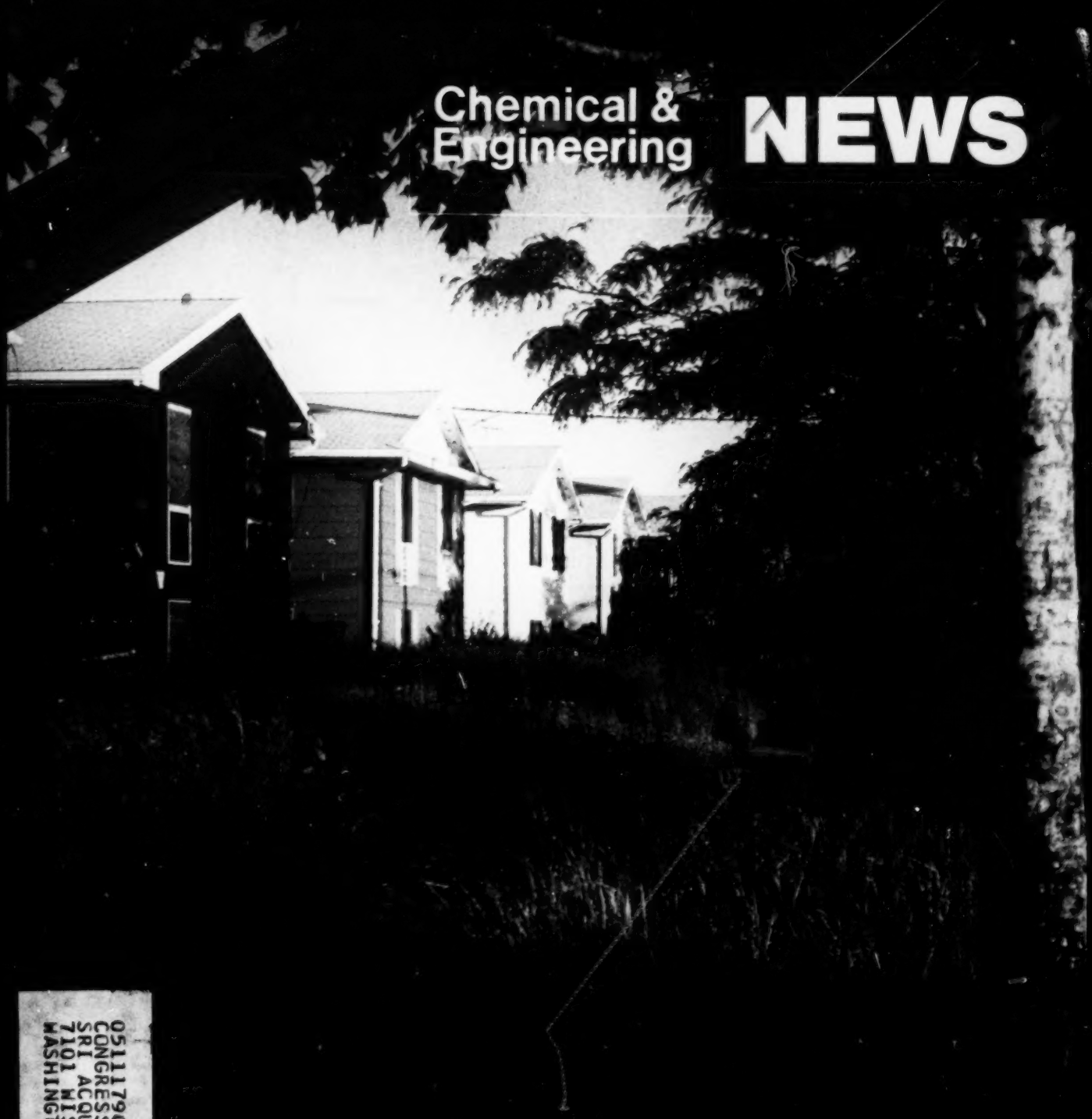
Chemical & Engineering NEWS



LOVE CANAL

Testing the frontiers of science and law Page 22

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Chemical & Engineering NEWS

Cover: Houses in Love Canal area were among the first group to be evacuated in August 1978. Photo by C&EN's Lois R. Ember

2 Letters
3 Editor's Page

Concentrates
7 Business
19 Government
30 Science/Technology

The Departments
39 ACS Comment
53 People
54 Newscripts

News of the Week

- ***The health effects of agent orange*** *and other phenoxy herbicides is the subject of three recent completed or planned studies in the U.S. and abroad.* ***Page 4***
- ***The U.S. and Canada*** *have signed a memorandum of intent setting up a committee to negotiate a transboundary air pollution treaty targeted for 1982.* ***Page 4***
- ***Synthetic fuels are competitive*** *with conventional fuels if the indirect cost of using imported oil is considered.* ***Page 5***
- ***ACS staff members prepare to shift the site*** *of the fall meeting from San Francisco to Las Vegas with as few disruptions as possible to meeting-goers.* ***Page 5***
- ***Charter Co. has called off its agreement*** *to purchase Commonwealth Oil & Refining, citing adverse changes in the Puerto Rican firm's operations.* ***Page 6***
- ***Fertilizers did fairly well*** *this spring thanks to exports, good business for ammonia and nitrogen solutions.* ***Page 6***

Business

- ***Combined second-quarter earnings*** *of 40 largest chemical companies surveyed by C&EN fell 12% to $1.3 billion even though sales increased 9%.* ***Page 8***

International

- ***Canadian chemical companies*** *report earnings up in second quarter and first six months, but prices and demand soften in important business areas.* ***Page 16***

Government

- ***Congress works toward Oct. 4 adjournment;*** *may have to complete unfinished business after November elections.* ***Page 20***

News Feature

- ***Solutions to the Love Canal problem*** *move to the courts and the political arena as scientific studies are suspect.* ***Page 22***

Science

- ***Pyrylium salts*** *expand use of aliphatic amines in synthetic chemistry in method being developed in England.* ***Page 31***

Technology

- ***Thin-film technologies for clinical use*** *give automated colorimetric and potentiometric assays of body fluids.* ***Page 33***
- ***Utilization of by-product liquids*** *of synthetic fuels production upgraded by Houdry's Litol process.* ***Page 34***

Books

- ***"Integrated Technology Transfer"*** *combines articles offering some insights but fails to provide unified view.* ***Page 37***

ACS News

- ***Former ACS president Alan Nixon*** *continues his suit against ACS in amended complaint to the California Superior Court.* ***Page 40***

Chemical earnings sag 12% in second quarter

Profits of major chemical companies dropped suddenly, sending profit margins for the quarter plummeting to 5.6% from last year's 7.0%

William J. Storck
and William F. Fallwell
C&EN, New York

The string of earnings increases has finally run out for the U.S. chemical industry. After six straight quarters of phenomenal gains by chemical companies, earnings growth did not just stop in the second quarter this year. It upended.

Combined earnings of the 40 largest chemical companies in C&EN's quarterly survey fell 12% to $1.3 billion in the second quarter. At the same time, combined sales increased 9% to $22.7 billion.

The drop in earnings would have been even more dramatic had it not been for smaller chemical companies propping up earnings of the larger ones. Among the 20 largest companies, earnings fell 16% to a combined $1.1 billion from the same period last year. At the same time, combined earnings of the 20 smaller companies were climbing about 22% to $219 million.

The drop in chemical earnings in the second quarter also dampened the earnings increase for the year to date. For the first half of 1980, earnings for the 40 companies gained 7%—this after a 21% increase in the first quarter.

The combined profit margin for these companies in the second quarter, 5.6%, is also quite a drop from the 7.0% profit margin achieved in the second quarter last year. The latest figure is at the lowest level since fourth-quarter 1977, when it dropped to 5.4%.

Chemical company executives lay the second-quarter drop in earnings squarely on the recession. For example, Irving S. Shapiro, chairman of Du Pont, says: "During the quarter the U.S. recession, which was felt initially in the automotive and housing industries, spread to almost all other U.S. markets, affecting most of our product lines."

John W. Hanley, chairman and chief executive officer of Monsanto, says, "Monsanto's second-quarter results clearly reflect the severity of the recession that we are now witnessing. While we had anticipated an economic downturn, we had not projected adequately the extent of the credit constraints imposed by the Federal Reserve and the significant impact that those credit constraints had on the demand for automobiles and housing."

Pennwalt chairman Edwin E. Tuttle notes the suddenness of the downturn. "Although the quarter started off strong, it turned soft rather abruptly," he says.

And William S. Sneath, chairman of Union Carbide, says that adverse effects on earnings were caused by "an across-the-board decline in domestic sales volume, reflecting softness in the U.S. economy. With volume dropping and raw material costs rising, and with no price relief over the prior quarter, the pressure on profit margins continued."

Executives also do not see an immediate end to the problems. James G. Affleck, chairman of American Cyanamid, says that, based on results thus far in 1980, "We now expect that earnings for the year as a whole will fall below the record level achieved in 1979. Our expectations are based on the likelihood that the U.S. recession will be deeper and longer than anticipated."

At Rohm & Haas, chairman Vincent L. Gregory Jr. says, "With the current state of the U.S. economy and continued inflationary pressure on our costs, we will find it difficult to reach last year's record earnings for the entire year." Harold E. Thayer, Mallinckrodt's chairman, says, "As

Chemical industry leaders for second-quarter 1980. . .

Rank	Sales $ Millions	Earnings $ Millions[a]	Profitability Earnings as % of sales
1 Du Pont	$3412.3	Du Pont $176.6	Texasgulf 24.6%
2 Dow Chemical	2522.7	Dow Chemical 171.2	Freeport Minerals 20.2
3 Union Carbide	2370.9	Union Carbide 149.9	Lawter Chemicals 15.6
4 Monsanto	1548.6	W. R. Grace 86.7	International Flavors 15.4
5 W. R. Grace	1541.4	Allied Chemical 73.0	Great Lakes Chemical 14.3
6 Allied Chemical	1364.1	Texasgulf 59.1	Lubrizol 12.1
7 American Cyanamid	837.0	Diamond Shamrock 56.3	Nalco Chemical 11.7
8 Celanese	803.0	Williams Cos. 52.3	Loctite 11.6
9 Diamond Shamrock	769.1	PPG Industries 39.7	Petrolite 10.7
10 PPG Industries	753.7	International Minerals 35.9	Baker Industries 9.9

a After taxes. Note: For 40 chemical companies listed on page 10.

. . . and for first-half 1980

Rank	Sales $ Millions	Earnings $ Millions[a]	Profitability Earnings as % of sales
1 Du Pont	$6980.2	Du Pont $421.0	Texasgulf 26.3%
2 Dow Chemical	5332.2	Dow Chemical 401.7	Freeport Minerals 21.4
3 Union Carbide	4936.5	Union Carbide 369.8	Lawter Chemicals 15.8
4 Monsanto	3371.1	Monsanto 187.4	International Flavors 15.2
5 W. R. Grace	2905.5	W. R. Grace 151.9	Great Lakes Chemical 15.1
6 Allied Chemical	2748.3	Allied Chemical 141.2	Lubrizol 12.5
7 American Cyanamid	1667.0	Texasgulf 136.7	Baker Industries 12.5
8 Celanese	1650.0	Diamond Shamrock 112.6	Loctite 12.0
9 PPG Industries	1550.0	PPG Industries 94.4	Nalco Chemical 11.4
10 Diamond Shamrock	1524.5	Stauffer Chemical 88.7	Petrolite 9.8

a After taxes. NOTE: For 40 chemical companies listed on page 10.

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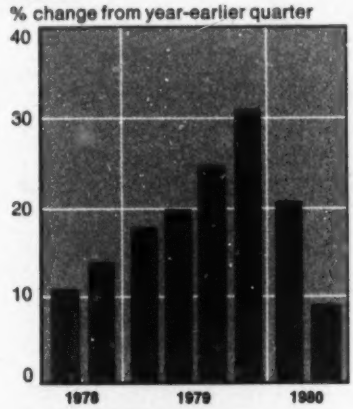
Chemical Industry Second-Quarter Results

- Sales were up 9%
- But earnings dropped 12%
- Profit margins fell
- Production decreased 1.8%
- Prices climbed 20%

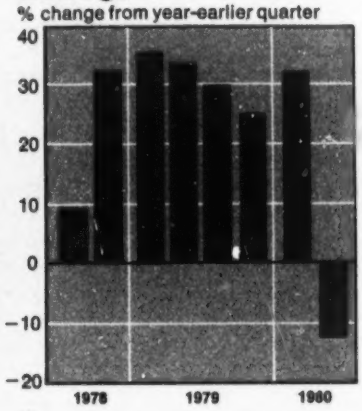
Sales

% change from year-earlier quarter



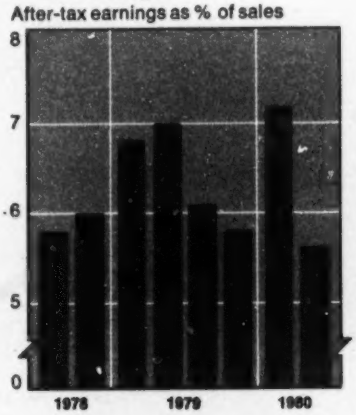
Earnings

% change from year-earlier quarter



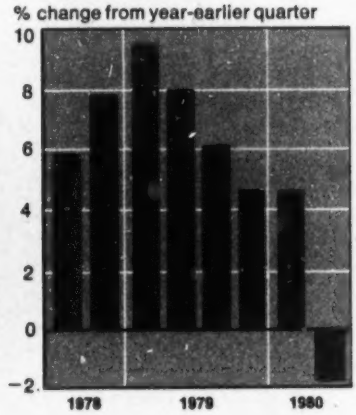
Profit margins

After-tax earnings as % of sales



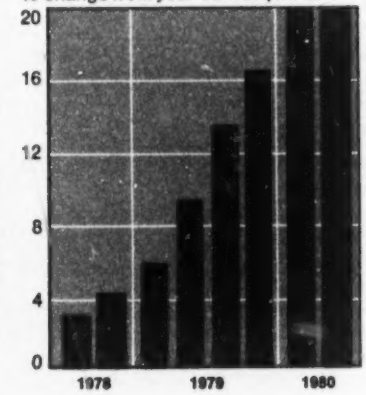
Production

% change from year-earlier quarter



Prices

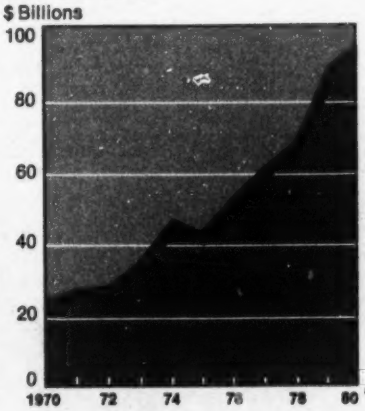
% change from year-earlier quarter



For 1980 sales likely will increase about 8% to top $94 billion; earnings will drop to $5.1 billion; profit margins will fall to 5.5%

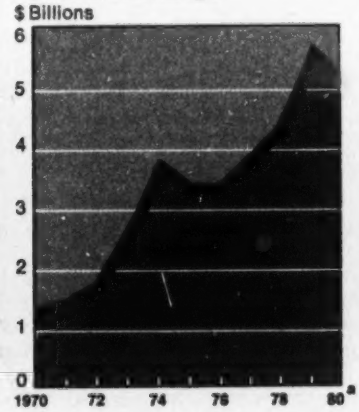
Annual sales

$ Billions



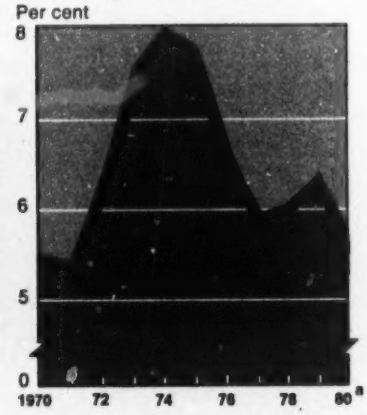
Annual earnings

$ Billions



Annual profit margins

Per cent



a C&EN estimates. **Note:** All sales, earnings, and profit margin data are based on the combined performance of the 40 largest chemical makers listed on page 10.

Second-quarter earnings dropped 12%, causing profit margins to fall to 5.6%

	SECOND-QUARTER 1980						FIRST-HALF 1980			
	Sales ($ millions)	Earnings ($ millions)	Change from 1979 Sales	Change from 1979 Earnings	Profit margin[a] 1980	Profit margin[a] 1979	Sales ($ millions)	Earnings ($ millions)	Change from 1979 Sales	Change from 1979 Earnings
Du Pont[c]	3,412.3	176.6	5	−34	5.1	8.3	6,980.2	421.0	11%	−18%
Dow Chemical	2,522.7	171.2	9	−20	6.8	9.3	5,332.2	401.7	22	3
Union Carbide[f]	2,370.9	149.9	4	−16	6.3	7.8	4,936.5	369.8	11	11
Monsanto	1,548.6	23.2	1	−61	1.5	3.9	3,371.1	187.4	7	−15
W. R. Grace[g]	1,541.4	86.7	13	47	5.6	4.4	2,905.5	151.9	15	53
Allied Chemical[h]	1,364.1	73.0	45	40	5.4	5.5	2,748.3	141.2	54	59
American Cyanamid	837.0	32.6	5	−25	3.9	5.4	1,667.0	70.6	8	−16
Celanese	803.0	25.0	−1	−44	3.1	5.6	1,650.0	61.0	6	−21
Diamond Shamrock	769.1	56.3	34	6	7.3	9.2	1,524.5	112.6	41	36
PPG Industries	753.7	39.7	−4	−31	5.3	7.4	1,550.0	94.4	3	−12
B. F. Goodrich	749.9	10.0	0	−59	1.3	3.3	1,520.0	30.0	1	−40
Hercules	624.0	26.9	6	−33	4.3	6.8	1,269.0	60.6	11	−21
Williams Cos.	574.1	52.3	9	96	9.1	5.1	1,053.9	87.4	11	155
International Minerals[i]	499.5	35.9	14	−2	7.2	8.3	959.0	82.9	18	20
Olin	483.4	27.2	2	−1	5.6	5.8	958.7	49.2	5	10
Rohm & Haas	467.1	27.0	10	−1	5.8	6.4	902.8	54.2	11	−2
Ethyl Corp.[j]	440.5	24.1	7	−8	5.5	6.4	879.1	45.3	12	−4
Stauffer Chemical	357.1	20.0	3	−20	5.6	7.2	940.0	89.7	11	3
Air Products	356.9	26.9	16	8	7.6	8.1	734.1	61.2	21	24
Pennwalt[k]	292.4	10.9	8	−22	3.7	5.2	595.2	23.2	12	−3
Akzona	244.4	1.4	3	−71	0.6	2.1	537.6	6.8	8	−53
Lubrizol	243.1	29.5	28	30	12.1	12.0	466.3	58.4	33	45
Texasgulf[l]	240.6	59.1	18	83	24.6	15.9	520.6	136.7	38	137
Reichhold Chemicals	213.2	0.2	−6	−97	0.1	2.6	449.5	4.4	4	−48
Thiokol	153.2	7.7	5	−7	5.0	5.7	308.1	17.3	10	11
Nalco Chemical	150.2	17.6	10	13	11.7	11.4	297.6	33.8	9	9
Freeport Minerals	147.6	29.8	20	18	20.2	20.7	304.0	65.1	33	43
International Flavors	123.4	19.0	10	6	15.4	16.1	245.2	37.3	15	11
Mallinckrodt	109.4	9.1	9	11	8.3	8.2	221.4	18.1	12	15
Liquid Air[m]	103.3	6.4	6	−9	6.2	7.2	210.2	14.6	20	22
First Mississippi	95.1	8.8	35	76	9.3	7.1	137.2	13.3	29	90
Petrolite	64.6	6.9	34	50	10.7	9.6	124.1	12.1	37	44
Crompton & Knowles	61.1	2.4	−3	26	3.9	3.0	122.9	4.5	0	41
Baker Industries	57.5	5.7	18	307	9.9	2.9	132.0	16.5	35	650
Loctite	51.7	6.0	11	−8	11.6	14.0	102.4	12.3	17	0
Virginia Chemicals	37.8	0.0	12	−99	0.1	5.3	78.0	1.5	17	−58
Stepan Chemical	37.6	1.4	3	−25	3.7	6.5	77.0	2.0	8	−41
Essex Chemical	37.5	1.3	16	−28	3.5	5.6	70.9	2.1	16	−32
Great Lakes	27.2	3.9	−12	−12	14.3	14.5	61.6	9.3	1	6
Lawter Chemicals	19.5	3.1	17	13	15.6	16.3	39.7	6.3	18	13
Total 20 largest companies[o]	$20,768.1	$1091.0	8%	−16%	5.2%	6.8%	$42,476.9	$2591.0	14%	2%
Total 20 other companies[o]	$2,218.0	$219.4	11%	22%	9.9%	9.2%	$4,506.3	$468.6	18%	41%
GRAND TOTAL[o]	$22,986.1	$1,310.4	9%	−12%	5.6%	7.0%	$46,983.2	$3,059.6	15%	7%

a After-tax income as percentage of sales. b For 12 months ending second-quarter 1980. c Fully diluted before nonrecurring items and extraordinary charges for continuing operations. d As of July 31. e Excludes nonrecurring charge of $35.1 million in second-quarter 1979. f Excludes $217.3 million gain for accounting changes in first-quarter 1980. Since previous quarters were not restated, 12-month profit margins are not comparable. 12-month earnings per share and price-earnings-ratio for Union Carbide are approximate. g Grace had $3.5 million nonrecurring loss in second-quarter 1980 and $2.0 million gain in second-quarter 1979 on divestments. h Allied Chemical had $12.7 million charge against earnings in second-quarter 1979. i International

the economy continues to slow, profit gains in the third quarter will become increasingly difficult."

And at Stauffer Chemical, chairman H. Barclay Morley says there will be continued depressed demand in U.S. chemical operations this year. Even though Stauffer's fourth quarter is expected to benefit from seasonal foreign and domestic shipments, the uncertain length and depth of the recession make it difficult to forecast overall results for the year, according to Morley.

Fibers continued to suffer during the quarter, and plastics suddenly took a downturn. For example, Celanese showed a loss of 10 cents a share in its U.S. nylon and polyester business, but this was buffered somewhat by gains in cellulosics and non-U.S. fibers. Monsanto had a $41.4 million loss in operating income in textiles for the quarter, although this was less than half the $91.5 million loss shown in the second quarter last year.

Producers are hesitant to predict a turnaround in fibers. Edward L. Hennessy Jr., Allied Chemical's chairman, says that he does not expect significant improvement in the fibers market this year.

Plastics suffered perhaps even more than fibers on a percentage-decline basis. B. F. Goodrich, the country's largest producer of polyvi-

FIRST-HALF 1980		12-MONTH RUNNING DATA[b]				Earnings per share[c]		STOCK MARKET DATA[d]		
Profit margin[a]		Change from 1979		Profit margin[a]						
1980	1979	Sales	Earnings	1980	1979	2nd qtr	Recent 12 months	Stock price	Price-earnings ratio July 31	Dividend yield, % of price
6.0%	8.2%	15	−7	6.6	8.1	1.19	5.88	43	7	4.7
7.5	8.9	30	17	7.8	8.7	0.94	4.10	36 1/2	9	4.4
7.5	7.5	13	34	6.7	5.7	2.25	10.40	43 3/4	4	7.3
5.6	7.0	14	−26	4.5	6.9	0.64	7.90	55 3/8	7	6.5
5.2	3.9	18	51	4.8	3.8	1.80	5.42	43 3/4	8	5.3
5.1	5.0	61	41	4.3	4.9	2.02	6.92	51 1/4	7	4.3
4.2	5.4	11	−5	4.7	5.5	0.68	3.17	28	9	5.7
3.7	5.0	12	−14	3.9	5.0	2.93	9.67	53	5	6.8
7.4	7.6	39	32	7.4	7.9	1.03	3.89	31 5/8	8	5.1
6.1	7.1	6	2	6.6	6.9	1.21	6.31	35 3/8	6	6.1
2.0	3.4	8	−35	1.9	3.1	0.57	3.32	21 7/8	7	7.1
4.8	6.7	15	−7	5.2	6.5	1.38	3.67	19 1/4	5	6.2
8.3	3.6	19	248	6.3	2.2	1.92	4.49	35 1/4	8	3.1
8.6	8.5	21	24	8.3	8.2	1.34	7.40	41	6	5.7
5.1	4.9	7	−3	4.1	4.6	1.13	3.20	20 1/8	6	5.0
6.0	6.8	18	26	5.9	5.5	2.10	7.63	47 3/8	6	4.9
5.2	6.1	15	5	5.4	6.0	1.17	4.65	31 3/8	7	4.8
9.5	10.3	13	1	8.5	9.6	0.45	3.10	19 7/8	6	6.0
8.3	8.1	21	26	8.2	7.9	0.95	4.04	45	11	1.8
3.9	4.5	16	−2	4.1	4.8	1.06	4.61	29 3/4	6	7.4
1.3	2.9	14	8	2.4	2.5	0.12	1.37	10 1/4	7	7.8
12.5	11.5	29	31	12.7	12.5	1.52	5.61	66 3/4	12	2.7
26.3	15.3	32	148	22.7	12.1	1.58	5.60	41 1/8	7	3.9
1.0	2.0	10	−43	0.9	1.8	−0.08	0.75	11 1/4	15	4.3
5.6	5.5	7	21	6.7	5.9	0.66	3.18	52 1/2	17	3.0
11.4	11.3	14	11	11.0	11.3	0.88	3.21	40 1/2	13	4.0
21.4	20.0	47	85	21.0	16.7	0.95	4.64	47	10	2.1
15.2	15.7	13	9	14.8	15.3	0.52	1.79	23 3/4	13	3.9
8.2	7.9	11	17	8.2	7.9	0.92	3.55	36 1/2	10	3.3
6.9	6.8	21	7	5.3	6.0	0.60	2.74	26 1/4	10	5.3
9.7	6.6	36	349	8.7	2.6	1.02	2.35	40 3/4	17	1.2
9.8	9.3	24	16	8.7	9.4	1.17	3.26	65	20	1.9
3.7	2.6	2	26	3.6	2.9	1.07	3.67	23	6	5.2
12.5	2.2	31	n	10.4	n	0.49	2.35	15 1/2	7	—
12.0	14.1	23	11	13.0	14.4	0.61	2.53	34 7/8	14	1.6
1.9	5.4	19	−57	1.5	4.1	0.01	0.80	13 1/4	17	5.1
2.6	4.8	14	−25	2.6	3.9	0.76	1.69	17 1/2	10	5.3
3.0	5.1	17	19	15.4	15.1	0.56	2.38	47 7/8	20	0.8
15.1	14.3	19	−34	2.8	5.1	0.56	1.64	11 7/8	7	6.7
15.8	16.5	18	15	15.9	16.7	0.27	1.03	11 3/4	11	5.1
6.0%	**6.8%**	**16%**	**9%**	**6.1%**	**6.4%**					
10.4%	**8.7%**	**19%**	**51%**	**9.9%**	**7.8%**					
6.5%	**7.0%**	**16%**	**14%**	**6.4%**	**6.6%**					

Minerals had net charge $4.3 million in second quarter. j Ethyl had $6.8 million charge in second-quarter 1980 and $7.3 million nonrecurring gain in first quarter. k Pennwalt had $2.6 million nonrecurring gain in second-quarter 1979. l Texasgulf had $4.1 million gain in second-quarter 1980 from change in accounting methods. m Liquid Air had $2 million gain in second quarter on sale of assets. n Deficit. o Averages except for sales and earnings.

nyl chloride resin, says that following the precipitous decline in new housing starts and other construction activity, U.S. industry shipments of PVC declined 30% compared to the first quarter. Carbide's plastics sales declined 3% for the quarter. Although not disclosed, the earnings decline probably was much larger because of higher raw material costs.

At Monsanto, sales of plastics and resins declined 15.8% during the quarter from the same period a year ago. Operating (pretax) income dropped to a loss of $13.3 million this year from $9.7 million last year.

The one remaining semibright spot for the chemical industry thus far seems to be foreign business. Carbide's Sneath says that foreign sales were up 13% for the quarter. G. J. Williams, financial vice president at Dow, comments that Latin America and some countries in Europe are showing continued strength. And at Loctite, E. Russell Eggers, president and chief executive officer, says that strong growth in Loctite's international sales and earnings did much to cushion the impact of the developing recession in the U.S.

Good non-U.S. business also was helpful for some of the more diversified U.S. chemical producers in the second quarter. For example, NL Industries says that European and Ca-

Earnings jump again at oil companies but not at diversified chemical producers

	% chemical sales	2ND-QUARTER 1980 Sales ($ millions)	Earnings ($ millions)	Change from 1979 Sales	Change from 1979 Earnings	Profit margin[a] 1980	Profit margin[a] 1979	FIRST-HALF 1980 Sales ($ millions)	Earnings ($ millions)	Change from 1979 Sales
OIL AND GAS COMPANIES										
Exxon	8%	$26,223.0	$1,030.0	41%	24%	3.9%	4.5%	$53,877.0	$2,955.0	44%
Mobil[b]	3	15,300.0	688.0	43	64	4.5	3.9	30,600.0	1,533.0	46
Texaco[b]	3	12,539.0	502.9	47	49	4.0	4.0	25,788.0	1,103.5	53
Standard Oil of California	3	10,649.0	535.0	53	40	5.0	5.5	21,096.0	1,162.0	51
Standard Oil (Ind.)	10	7,291.0	488.2	57	39	6.7	7.6	13,742.5	1,064.2	52
Gulf Oil[b]	9	6,800.0	370.0	11	27	5.4	4.8	14,556.0	759.0	25
Atlantic Richfield	10	5,642.2	434.8	51	67	7.7	7.0	11,075.9	860.9	53
Shell Oil	16	4,895.0	407.0	44	47	8.3	8.1	9,693.0	780.0	50
Conoco	6	4,700.0	249.6	57	16	5.3	7.2	9,000.0	578.0	55
Phillips Petroleum	20	3,230.0	214.8	45	0	6.7	9.8	6,610.0	499.3	57
Tenneco	13	3,201.0	186.0	18	22	5.8	5.7	6,517.0	364.0	27
Sun Co.	3	3,000.0	247.0	20	48	8.2	6.7	6,100.0	498.3	24
Occidental Petroleum	22	2,998.6	161.1	34	52	5.4	4.7	6,345.2	439.0	56
Standard Oil (Ohio)	5	2,800.0	451.3	56	124	16.1	11.2	5,500.0	902.0	57
Union Oil	11	2,751.4	194.8	47	52	7.1	6.9	5,127.0	347.7	41
Getty Oil	3	2,643.3	243.1	130	74	9.2	12.1	4,912.0	469.0	119
Ashland Oil[b]	13	2,121.8	47.7	17	−5	2.3	2.8	4,121.0	95.1	25
Cities Service	8	1,814.3	107.0	27	40	5.9	5.4	3,986.3	277.1	39
El Paso	11	924.5	6.1	23	−85	0.7	5.4	1,952.9	40.9	45
Kerr-McGee	16	854.2	49.6	32	14	5.8	6.8	1,634.6	96.7	31
DIVERSIFIED MANUFACTURERS										
Engelhard Minerals	1	6,684.4	139.1	74	136	2.1	1.5	12,619.0	280.5	89
General Electric	2	6,200.0	402.6	10	5	6.5	6.8	12,080.0	744.1	13
U.S. Steel[b]	9	3,100.0	111.5	−14	−26	3.6	4.2	6,300.0	222.7	−6
Eastman Kodak	20	2,130.7	272.5	18	22	12.8	12.4	4,267.7	488.4	24
Goodyear	12	2,071.3	43.1	−3	−19	2.1	2.5	4,094.8	93.8	−1
Esmark	8	1,772.2	26.0	4	11	1.5	1.4	3,424.9	47.4	6
3M	15	1,518.0	157.3	13	−3	10.4	12.0	3,012.0	324.6	14
Aluminum Co. of America[b]	9	1,290.6	121.5	9	0	9.4	10.4	2,593.1	265.0	9
Firestone[b]	13	1,286.1	−3.0	−5	c	c	2.4	2,463.3	−16.8	−4
Borden	34	1,276.3	39.7	14	8	3.1	3.3	2,346.4	70.3	13
Georgia-Pacific	10	1,197.0	55.0	−11	−42	4.6	7.1	2,422.0	105.0	−1
Kaiser Aluminum	14	939.0	82.2	17	38	8.8	7.4	1,689.1	155.7	12
FMC	34	875.7	39.3	3	−10	4.0	5.1	1,749.1	80.1	8
Pfizer	14	734.5	57.6	8	3	7.8	8.3	1,444.6	123.0	10
Northwest Industries	7	684.5	31.6	7	−30	4.6	7.0	1,341.8	62.1	9
Merck	16	674.8	114.9	13	11	17.0	17.2	1,329.8	220.9	14
Borg-Warner	22	669.6	31.5	−6	−27	4.7	6.1	1,349.0	67.4	1
North American Philips[b]	14	656.4	16.3	6	−19	2.5	3.3	1,248.8	32.3	7
Martin Marietta	12	643.8	58.8	23	9	9.1	10.3	1,210.9	93.3	26
Eli Lilly	21	599.9	78.3	8	−10	13.1	15.7	1,317.5	194.7	12
Uniroyal	23	593.2	−2.6	−18	c	c	c	1,173.4	−14.7	−18
Dart Industries[b]	26	565.5	44.9	−9	7	7.9	6.7	1,125.0	81.1	−6
General Tire	21	529.9	6.9	−12	−79	1.3	5.4	1,043.3	−4.4	−7
National Distillers[b]	37	512.7	29.6	−1	−3	5.8	5.9	1,071.2	72.7	1
NL Industries[b]	30	510.3	39.8	11	36	7.8	6.4	1,016.0	76.3	16

a After-tax income as percentage of sales. b Excludes major nonrecurring earnings; Mobil—$459 million in first-quarter 1980; Texaco—$402 million in first-quarter 1980; Gulf Oil—$100 million in second-quarter 1980; Ashland Oil—$345.1 million in second-quarter 1979. $3.4 million loss in first-quarter 1979; U.S. Steel—$14.8 million in first-quarter 1980 and $90.4 million in first-quarter 1979; Alcoa—$27.3 million in second-quarter 1979 and $12.3 million in second-quarter 1979; Firestone—$49 million charge in second-quarter 1980; North American Philips—$3.6

FIRST-HALF 1980			STOCK MARKET DATA							
Change from 1979	Profit margin[a]		Earnings per share		Stock price			Price-earnings ratio	Annual indicated	Dividend yield, %
Earnings	1980	1979	2nd qtr	Recent 12 months	July 31	Recent 12 months High	Low	July 31	dividend	of price
66%	5.5%	4.8%	$2.36	$12.46	69⅝	72¾	52	6	$5.60	8.0%
77	5.0	4.0	3.24	12.97	74¼	89½	38	6	3.40	4.6
72	4.3	3.8	1.87	8.20	36¼	41⅝	27	4	2.40	6.6
60	5.5	5.2	3.13	12.99	74½	89	45¾	6	3.60	4.8
52	7.7	7.8	1.68	6.37	58⅞	65	16	9	2.20	3.7
41	5.2	4.6	1.90	7.90	40	54½	26¾	5	2.50	6.3
71	7.8	6.9	1.75	5.60	45	50½	43	8	1.90	4.2
56	8.1	7.7	1.32	4.56	36⅜	40¾	34	8	1.40	3.9
53	6.4	6.5	2.32	9.44	53¾	59	37⅞	6	2.20	4.1
27	7.6	9.3	1.41	6.49	41	61⅛	37	6	1.80	4.4
32	5.6	5.4	1.52	5.80	41	45½	31¼	7	2.40	5.9
69	8.2	6.0	1.95	7.17	37⅞	40⅞	33¼	5	1.80	4.8
133	6.9	4.6	1.87	9.69	26¼	31⅞	19	3	2.00	7.6
145	16.4	10.5	1.83	7.05	45	52½	42¼	6	1.40	3.1
43	6.8	6.7	2.25	6.99	56½	62½	37½	8	1.60	2.8
89	9.6	11.0	2.95	10.03	82¾	97¾	51½	8	1.80	2.2
23	2.3	2.4	1.57	6.62	36	42¾	25¾	5	2.20	6.1
79	7.0	5.4	1.29	5.65	33¼	39⅜	29⅜	6	1.60	4.8
−43	2.1	5.3	0.13	2.29	20⅜	30½	15¾	9	1.48	7.3
26	5.9	6.2	1.91	6.93	74⅛	85	52	9	1.80	2.4
163	2.2	1.6	2.03	7.60	41⅜	42½	20⅛	5	1.16	2.8
9	6.2	6.4	1.77	6.45	56¼	57½	44	9	3.00	5.3
13	3.5	2.9	1.28	−3.15	24	24½	16¼	c	1.60	6.7
16	11.4	12.2	1.69	6.63	61¼	62⅝	42⅞	9	2.40	3.9
−13	2.3	2.6	0.59	1.83	15¼	16¼	10¾	8	1.30	8.5
16	1.4	1.3	1.14	4.54	49¾	49⅞	24½	11	1.84	3.7
3	10.8	11.8	1.34	5.68	58¾	59⅜	46¼	10	2.80	4.8
6	10.2	10.5	3.40	14.36	69	70⅞	48⅜	5	3.20	4.6
c	c	2.6	−0.05	0.32	8	12¾	6⅛	25	0	0
7	3.0	3.2	1.21	4.25	26	27⅞	19⅝	6	1.90	7.3
−39	4.3	7.0	0.51	2.42	29⅛	34⅞	21½	12	1.20	4.1
35	9.2	7.7	1.87	6.19	25	25⅝	15⅜	4	1.40	5.6
−3	4.6	5.1	1.08	4.12	25¼	31⅛	21⅝	6	1.40	5.5
7	8.5	8.7	0.79	3.36	42⅞	44⅝	30⅝	13	1.44	3.4
−21	4.6	6.5	1.02	5.03	30¾	37⅞	24¾	6	2.28	7.4
14	16.6	16.6	1.53	5.43	77¼	78¼	58¼	14	2.30	3.0
−14	5.0	5.8	1.47	6.75	37¾	42⅞	29¾	6	2.30	6.1
−4	2.6	2.9	1.20	5.54	31⅜	32	23½	6	1.70	5.4
8	7.7	9.0	2.36	7.41	54¾	57⅜	34¼	7	2.32	4.2
2	14.8	16.2	1.04	4.58	54⅜	63⅞	45¾	12	2.10	3.9
c	c	0.2	−0.10	−1.89	4¼	6	3⅛	c	0	0
6	7.2	6.4	1.70	5.87	42⅛	49⅝	35⅛	7	2.00	4.7
c	c	4.0	0.29	1.36	28¾	32½	22	21	2.00	7.0
16	6.8	5.9	0.86	3.84	49¾	51⅞	23⅞	13	1.20	2.4
52	7.5	5.7	1.17	4.02	27½	31¾	19	7	1.40	5.1

million in second-quarter 1979 and $5.1 million in first-half 1979; Dart Industries—$9.7 million in second-quarter 1980; National Distillers—$17 million in second-quarter 1979; NL Industries—$26.3 million in first-half 1979. c Deficit.

BEST AVAILABLE COPY

Petrochemical earnings at leading oil companies join the slide

True to their roller-coaster profits tradition, petrochemicals magnified the earnings downsweep in the U.S. chemical industry in the second quarter. While worldwide after-tax earnings at the largest basic chemical companies fell 12% in the quarter from second-quarter 1979, combined after-tax earnings for petrochemicals at seven major oil companies sank 25%.

Petrochemical earnings still managed an overall 14% gain for the first half of 1980 over first-half 1979 at these companies, and the reduced earnings of the second quarter still kept a fairly healthy profit margin on sales. However, the direction was clear, and bad. Since leading petrochemical prices have suffered further discounts in the third quarter, and since foreign economies are rapidly joining the U.S. recession, petrochemical earnings' plunge probably will continue for a while.

"Declines occurred both in the U.S. and abroad as a result of softer margins and lower sales volume," says C. C. Garvin Jr., chairman of Exxon, about second-quarter petrochemical earnings. Exxon is the leading petrochemical producer and ranks third among all U.S. chemical producers behind Du Pont and Dow Chemical. "In the U.S., where second-quarter earnings were only one half those of the first quarter, [physical] sales volume was 16% lower."

On first-half petrochemical performance, Garvin notes Exxon's 24% earnings improvement over first-half 1979. But that was thanks to good earnings outside the U.S. "Foreign earnings were up 73% from improved margins. Margins also were higher in the U.S., but the earnings effect was more than offset by increased operating expenses; earnings in the U.S. declined 17%. Worldwide [physical] sales volume of chemical products declined 3%."

Conoco's second-quarter report also complains of lower chemical sales volumes. At Gulf Oil, the comment is that U.S. product prices and sales volumes for major petrochemicals and plastics eroded sharply in June as the recession deepened.

Bits of product data from companies hint the severity of the physical volume drop. For example, Cities Service says that its sales of petrochemical intermediates were about 235 million lb in the second quarter, down 14% from second-quarter 1979 and down 28% from first-quarter 1980. Gulf Oil says that its worldwide chemical sales were 3.1 billion lb in the second quarter of 1980, off 9% from both second-quarter 1979 and first-quarter 1980.

Even so, petrochemical profitability was still respectable in the second quarter, a few other company reports indicate. For example, Shell Oil's chemical segment income (after taxes but before corporate overhead) was 7.1% of chemical revenues in the second quarter although down from 9.0% a year ago.

AFTER-TAX EARNINGS

	Second quarter			First half		
$ Millions	1980	1979	% change	1980	1979	% change
Conoco	$ 18.2	$ 23.8	−24%	$ 43.7	$ 37.3	17%
Exxon	107.0	127.0	−16	269.0	217.0	24
Gulf Oil	56.0	75.0	−25	127.0	114.0	11
Mobil	26.0	34.0	−21	62.0	59.0	5
Shell Oil	54.0	59.0	−8	77.0	73.0	5
Standard Oil (Ind.)	46.1	77.2	−40	105.3	90.6	16
Texaco	9.1	23.5	−61	39.2	40.8	−4
TOTAL	$318.4	$419.5	−25%	$723.2	$631.7	14%

nadian titanium pigment results were the main reason for a 12% year-to-year earnings gain in its chemical operations. However, NL adds that overall demand weakness in chemicals late in the quarter probably will reduce its chemical earnings in the second half of 1980.

A few other solid increases in chemical earnings dot the generally negative reporting of other diversified companies on chemical operations. One of these was Uniroyal, which is under financial siege in its tire operations. Chemicals at Uniroyal increased their operating (pretax) profit 16% in the second quarter from a year ago on a 9% sales gain.

Another example might be Eastman Kodak's chemicals division, which had a 14% sales increase led by fibers and plastics in the second quarter from second-quarter 1979. However, Eastman Kodak says nothing about chemical earnings.

At other companies, widespread reports of second-quarter earnings weakness in polymers indicate that gains in sales didn't necessarily make it to the bottom line. For example, National Distillers, in explaining a drop in its chemical earnings for the second quarter from a year ago, mentions "substantial volume declines for all major products" and "increased petrochemical raw materials costs."

More specifically, Distillers adds, "Selling prices for the important polyethylene products weakened late in the quarter, and this trend is continuing." Distillers also says that low operating rates and sporadic operations at its new synthesis-gas-based complex outside Houston hurt earnings. Distillers and partner Du Pont have been starting up units at this complex over the past year.

The end markets most responsible for trouble in polymers and other chemical products in the second quarter were the familiar hard-pressed durables—autos and housing. A typical comment comes from Borg-Warner chairman James F. Bere, who says the company's first year-to-year earnings decline in five years came in the second quarter at the hands of poor transportation and housing markets.

At Georgia-Pacific, chairman Robert E. Flowerree says, "We've had some weakness in chemicals associated with the construction industry, like thermosetting resins and some of their feedstocks, as well as polyvinyl chloride resin." However, he says, "Other chemical lines such as methanol and ammonia are running at capacity with excellent demand and firm prices."

Georgia-Pacific's luck with agriculturally oriented ammonia was shared by some other diversified chemical producers such as Kaiser Aluminum & Chemical in the agricultural market sphere. But more reports of earnings damage in this area are cropping up. For example, Eli Lilly says that sales of its Treflan herbicide declined in the second quarter from a year ago because of adverse weather and lower acreage in some parts of the U.S. and Canada.

At Northwest Industries, operating (pretax) earnings fell 79% at pesticides-producing Velsicol, its chemical segment, in the second quarter from a year ago. FMC also says earnings and sales fell in agricultural chemicals from second-quarter 1979.

Hence, agriculture, a formerly safe earnings haven, has joined durables and other markets as a trouble spot for many companies. For the future, the third quarter is too early for any earnings relief as may be the fourth. Rates of decline appear to be easing, but recovery is not yet in sight. □

Canadian chemicals feel the recession

Earnings were up for three of four largest firms in second quarter and first six months, but growth rate has slowed considerably from last year

Like their U.S. counterparts, Canada's four largest publicly reporting chemical companies—C-I-L Inc., Celanese Canada, Du Pont Canada, and Union Carbide Canada—are being squeezed by the recession. Although three of the four still could boast of higher earnings for the second quarter and the first six months than in the previous year's comparable period, it was evident that the growth rate was slowing.

Combined second-quarter sales of the four firms was almost $812 million (Canadian), a 12% increase from second-quarter 1979. Net income for the four reached $58.3 million, a 30% gain. For the first half, sales totaled $1.58 billion, up 16% from the 1979 period. Earnings came to nearly $109 million, up 54%. That sounds pretty good, but it's skewed by disparities among the companies, and it's a sharp comedown from the over-100% quarterly gains that were typical of much of 1979. Profit margins held up fairly well; return on sales averaged 6.9% for the four companies, with a range of 5.4% to 11.2%.

C-I-L's second-quarter sales amounted to more than $282 million, a 10% increase from the like 1979 period. Net income increased 18% to $19.4 million. For the first six months, sales totaled more than $510 million, up 12% from first-half 1979. Net income for the period was $29.0 million, up 42%.

According to C-I-L president W. J. Mandry, sales gains in most major lines, together with improved operating efficiency, more than offset rising material and manpower costs. However, effects of the economic slowdown began to appear late in the second quarter, with prices and demand softening in several important business areas. But sales and earnings for the full year are still expected to be "comfortably ahead of 1979."

For companies with heavy involvement in fibers and textiles, the downturn had become evident earlier. At Celanese Canada, for example, second-quarter sales of more than $100 million represented a 12% increase from the second quarter of 1979. But net income came to only $5.5 million, a 13% decline. For the first six months, sales reached almost $200 million, a 14% increase, but earnings declined 5%, to $10.7 million. Celanese president Richard M. Clarke calls the results satisfactory, considering the overall state of the economy.

Things were a little better at Du Pont Canada, but earnings growth was down sharply compared to the company's strong recovery in 1979. Second-quarter sales rose 11% from the corresponding 1979 period, to almost $248 million, but net income rose only 4.2%, to $13.6 million. In the first half, sales totaled about $482 million, up 16% from the first half of 1979, and earnings came to $26.2 million, up 21%.

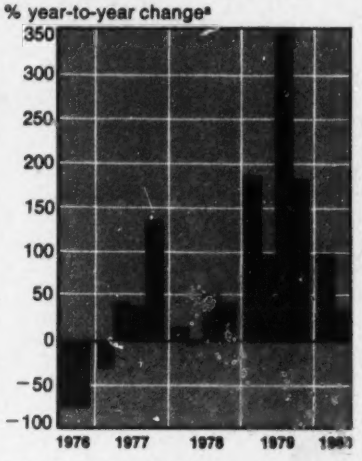
President J. E. Newall notes that demand for many Du Pont products dropped in the second quarter, with fibers activity particularly affected by slower business and by startup costs at a Quebec polyester plant.

At Union Carbide Canada, the recession usually hits later, and this year seems to be no exception. Carbide sales amounted to more than $181 million in the second quarter, 16% ahead of last year's second quarter. Net income rose a healthy 127% to $19.8 million. For the first six months, sales reached $384 million, a 24% gain from the like 1979 period. Earnings came to $42.9 million, a 150% increase from the 1979 period (when Carbide wasn't doing so well) and a return on sales of a little better than 11%. The company points out, however, that about 23% of the apparent earnings improvement resulted from various changes in accounting procedures.

Most product lines had first-half sales gains, Carbide notes, with carbon products particularly strong. Exports increased 33%, to $44.4 million. The downturn will "moderate" second-half results, according to Carbide president J. S. Dewar. But he still expects full-year earnings to exceed 1979's, even without the accounting change benefits.

Ward Worthy, Chicago

Earnings growth rate shows downward trend



[a] After-tax earnings of four largest publicly reporting Canadian chemical companies—Celanese Canada, C-I-L, Du Pont of Canada, and Union Carbide Canada.

Return on sales holds up fairly well in first half

	First six months, 1980					
$ Millions (Canadian)	Net sales	Change from 1979	Net income	Change from 1979	Profit margin[a] 1980	1979
C-I-L Inc.	$ 510.1	13%	$ 29.0	42%	5.7%	4.5%
Celanese Canada	199.6	14	10.7	−5	5.4	6.5
Du Pont Canada	482.3	16	26.3	21	5.4	5.2
Union Carbide Canada	384.0	24	42.9	150	11.2	5.5
TOTAL	$1576.1	16%	$108.8	54%	6.9%	5.2%

[a] Net income as percentage of sales.

Uncertain science pushes Love Canal solutions to political, legal arenas

Lois R. Ember
C&EN, Washington

> ***"The important scientific problems at Love Canal are that little is known about the toxicity of the chemicals, and that it is difficult to use health surveys and epidemiological studies to associate exposure to chemicals from dump sites with human health effects. We do not have markers that help us associate disease with prior chemical exposure. Moreover, in a statistical sense, most dump areas impact on the health of relatively few people, and it is difficult to detect relatively rare events in small populations. Because we can't generalize about the toxic effects of multiple chemical exposure, it is almost impossible to estimate the health impacts of such exposure other than to assume that they are simply additive."***
> ***—David Rall, director, National Institute for Environmental Health Sciences***

Love Canal is the nation's first notorious episode of land pollution. This violated chemical grave haunts the residents of the area, stalks the company that buried the wastes, and tests the mettle of governments charged with protecting their citizens and the environment. In short, the precedent-setting potential of Love Canal has hampered efforts toward a permanent solution to the cleanup of the landfill, the speedy relocation of residents, and the execution of well-designed health and environmental studies.

As the first chemical dump to release its toxic legacy, it is fitting that Love Canal is located in that part of New York state known as the Niagara Frontier. Resolution of the not-so-mute medical, legal, and moral issues swirling about Love Canal will extend the frontiers of environmental health, the law, and corporate responsibility.

Testing the frontiers of events has always been Love Canal's hallmark. William T. Love, a turn-of-the-century entrepreneur, tested his dream there. He would build a navigable power canal connecting the upper and lower levels of the Niagara River, and this 7-mile-long trough producing cheap electricity would bring industry and commerce to his planned model city. His dream, however, never materialized. An economic depression and the invention of alternating current contrived to stifle it after only 3000 feet of his canal had been dug. For the next 30 years, the canal, one-quarter mile from the Niagara River, served only as the neighborhood swimming hole.

Then in 1942 Hooker Electrochemical Corp. (now Hooker Chemical & Plastics, a subsidiary of Occidental Petroleum Corp.) obtained permission to dispose of its chemical wastes in the canal. In 1947 it bought the 16-acre property. And for 11 years until 1953, when it deeded the land to the Niagara Falls Board of Education for a token $1.00, the company used Love Canal as a burial vault for more than 21,000 tons of its wastes.

It wasn't a final resting place for this chemical soup. Twenty-five years later, excessive rains and melting snow penetrated the canal's cover, and the rising water table carried the "Love Canal leachate," a sweetly aromatic, oily black ooze, out of its grave and into the backyards and basements of homes that had been built adjacent to the landfill.

The canal residents believed that the chemical ooze brought disease and death, and they lobbied for relief. In August 1978 relief came, after 82 chemicals, 11 of them suspected human carcinogens and one—benzene—a known human carcinogen had been identified by New York state and the Environmental Protection Agency in air, water, and soil. Some 239 families in the first two rings of homes bordering the canal were evacuated, their homes were purchased by the state, the 99th St. School built over the center of the landfill was closed, and a six-block area was cordoned off by an 8-foot-high chain link fence.

Since then additional environmental and medical studies, some under dispute, have tracked chemical migration and disease beyond the 1978 evacuation lines. Attendant publicity has made the homes caught in the ever widening net worthless, and area citizen groups, of which the Love Canal Homeowners Association is the most vocal and effective, have been clamoring for permanent relocation. But caught in bureaucratic cross fire, the residents remain in economic, medical, and legal limbo. Migrating toxic chemicals plus government ineptness have not brought them evacuation, only fear, frustration, and a nightmare beyond their control.

Mounting strain in the community may account for many of the illnesses reported by the residents. Unfortunately, it is not yet possible to separate chemical-induced illness from stress-induced disease. In the absence of sound medical science, anecdotal evidence fills the void. This evidence fuels the residents' fears and further adds to psychological stress.

At this point, the only humanitarian gesture left is to evacuate the additional 710 families covered by President Carter's May 21 declaration of a health emergency at Love Canal, say Rep. John J. LaFalce, whose district includes the Love Canal area, and New York Gov. Hugh Carey. Cynical but realistic, the residents expect to be moved out in this Presidential election year. Their expectation may be realized soon. Just

two weeks ago, the federal government offered the state a long-term $15 million loan at 8.25% interest. The state was cool to this offer, but dickering is going on. Once the residents are assured of permanent relocation, they may be more willing to participate in federal health and environmental monitoring studies.

Hooker, the company that buried the toxic chemical wastes, disavows all liability. It argues that it disposed of the chemicals in an impervious clay vault using state-of-the-art techniques for the period. Hooker also says that under threat of eminent domain, it transferred the property to the school board, which wanted to build a school on it, and that the deed of conveyance contained a paragraph warning that the landfill had been filled with "waste products resulting from the manufacturing of chemicals," and that Hooker disclaimed all liability for injuries occurring as a result of these "industrial wastes" after the property transfer. Furthermore, on subsequent occasions it went before the school board to warn it against construction on the property that might result in disturbance of the "dangerous chemicals" buried there.

Additionally, Hooker claims that before property transfer it placed over the landfill a clay covering whose integrity was later breached by the construction of city roads, an expressway, and the removal of thousands of cubic yards of dirt. By Hooker's analogy, precipitation penetrated the violated cover, and the buried chemicals rose with the water table, overflowing the canal banks like a stoppered, unattended bathtub.

Hooker will have to defend these claims in court. Compensatory and punitive damage suits brought against the company by New York state, the Justice Department on behalf of EPA, and 1300 private individuals total billions of dollars, with some estimates as high as $11 billion. Sophisticated analytical tools are dissecting the chemical miasma of Love Canal, but the courts will resolve the conflicting responsibilities and liabilities born of that miasma.

Unfortunately, as a result of litigation and governmental haggling and bungling, families are being destroyed and the social fabric of the community is being rent. This human suffering plus EPA's estimate of 32,000 to 50,000 other toxic waste sites in the U.S. have made Love Canal the rallying cry for superfund legislation to finance the cleanup of abandoned waste dumps. And to prevent a repetition of the ineptness that has characterized government response to Love Canal, EPA has assembled a "superfund task force" that is readying itself to respond to future hazardous waste episodes.

The time it has taken to parcel out blame, responsibility, and costs, though adding to mounting stress, has done little to uncover a relationship between exposure to toxic chemicals known to be buried in the canal and illnesses reported by the residents. Finding the tools to make this causal nexus strains both medical and environmental sciences and probes the frontiers of environmental health.

Sleuthing for causes of present day diseases that may have resulted from exposure to chemicals years before would tax even the skills of Sherlock Holmes, Still, New York and EPA have made fitful stabs at it over the past two years, and even now EPA and the Center for Disease Control (CDC) stand ready to mount more comprehensive and, it is hoped, better designed environmental and health studies. These await resident cooperation and permission to enter private homes.

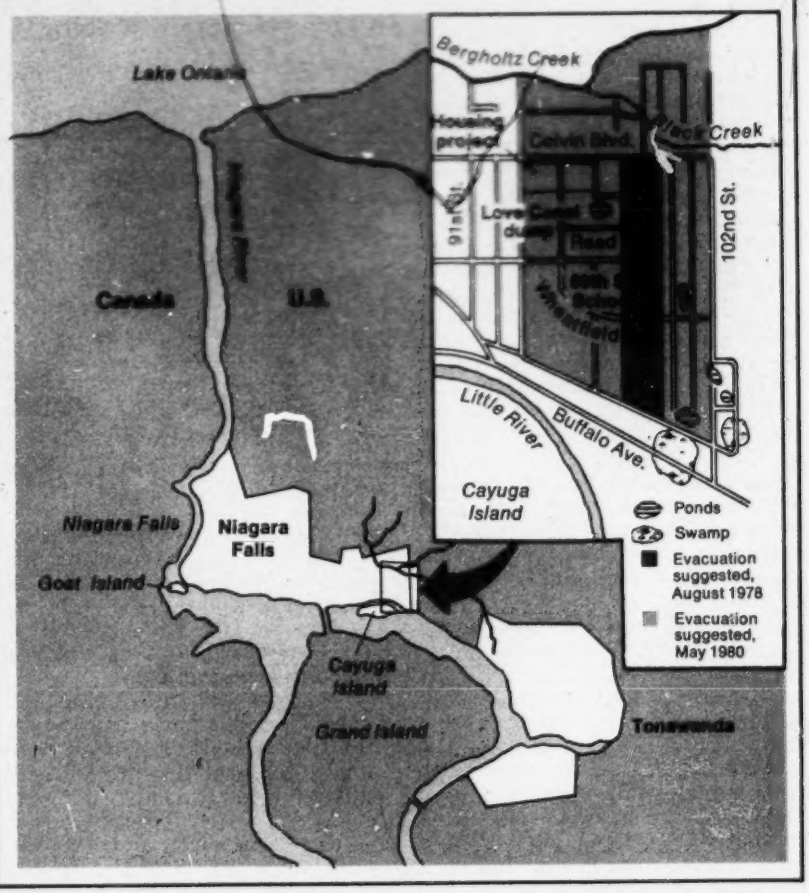
Love Canal, quite simply, has been a learning experience, one in which traditional scientific tools and modes of inquiry have been found wanting. As the governments have worked their way through this learning maze, mistakes have been made, and inadequate explanations of findings have been given to the residents.

Government ineptitude, however, does not change the fact that toxic chemicals were placed in the ground by Hooker. And, although Hooker believed that its disposal practices were safe, neither it nor subsequent owners monitored the chemical grave in any regular fashion for decades. The lack of monitoring allowed migrating chemicals to go undetected for nearly 25 years.

Then in 1976 they literally surfaced. A tentative 1976 monitoring effort by the New York Department of Environmental Conservation, plus the "constant badgering" of Rep. LaFalce from 1977 on, set into motion the cavalcade of environmental and health studies that comprise the history of Love Canal. These studies—some limited in scope, others in hindsight, poorly designed, incorrectly or still not analyzed—became the basis for two health emergency declarations in two years.

The first, in August 1978, was state initiated and ordered remedial con-

Love Canal dump affects a widening area



struction work to begin at the landfill to contain the chemicals. Because families living in homes built adjacent to the canal could be exposed to increased dangers, Gov. Carey ordered these families' permanent relocation. This set a precedent that 710 families affected by President Carter's May 1980 order hope to bank on in getting the federal government to buy their homes. Between these two orders, haggling intensified because neither the state nor the federal government wanted to claim ultimate responsibility for the care of the residents.

The first evacuation of 239 families raised the level of fear in the families remaining. Frequent testing, but infrequent or inadequate explanations of findings turned their fear to frustration. Frustration evolved into determination to get out. One exit ticket: Hold future tests hostage until a pledge of permanent removal is obtained. This standoff between big government and a besieged lower-middle-class community is the state of affairs today.

This situation was reached in traumatic jolts. Contamination became obvious in late 1977, and early 1978. Then, a black, oily scum containing pesticides, solvents, and other toxic chemicals lay in pools on the surface of the landfill. Residents' complaints of this chemical ooze in their backyards and basements prompted the state to call in EPA. In February 1978, EPA took air scans, mostly in the basements, of 14 homes abutting the canal and identified 26 organic compounds.

EPA's findings elicited an expanded effort by the state Department of Health in the spring. Air in all the homes on 97th and 99th Streets—the first two so-called rings surrounding the landfill—was sampled; water was collected from those homes that had sump pumps; soil samples from the landfill and around the homes were collected; leachate from the canal was taken for analysis. At the same time, a medical survey was conducted on these families; blood samples were also drawn.

The finding of 80 chemicals in the air, water, soil, and leachate plus a higher rate of miscarriages—more than 1.5 times the norm—and birth defects in families living around the southern part of the canal led to the state's declaration of a health emergency.

A separate epidemiological study was launched by the Love Canal Homeowners Association under the guidance of its scientific adviser, Beverly Paigen, a cancer research scientist at Roswell Memorial Park Institute in Buffalo, N.Y. Paigen apparently was able to correlate clusters

C&EN staff photos

One man's dream becomes a neighborhood's continuing nightmare

of diseases—miscarriages, birth defects, respiratory illnesses, and others—with swale or wet areas. Swales, several of which cross the canal, are dried up streambeds that may serve as preferential routes of chemical migration from the canal.

Her survey, not without flaws, was nevertheless found by a then-Health, Education & Welfare panel to merit further study and has, in part, been validated by an expanded state epidemiological survey. The state's study also correlated swales and other historic wet areas with higher rates of miscarriages, lowered birth weights and, possibly, elevated rates of birth defects.

Raw data from this epidemiological study have not been made public; the state argues patient confidentiality. EPA, Hooker, the home owners association, and others have all sought the data. A U.S. District Court in Buffalo is now mediating release of the data to EPA, Hooker, the home owners, and also to the Center for Disease Control, which plans to begin its health studies sometime this month.

Lois Gibbs, president of the home owners association, believes that the state has withheld the data for three reasons. First, she says, there is a high health risk to residents living in the area. The state knows this, but cannot afford to spend much more than the $35 million it already has spent on remedial cleanup and purchase of 239 homes. Second, if the state acts to relocate permanently all affected Love Canal families, a precedent will be set. With its own recent survey identifying 680 hazardous waste dumps across the state, 68 in Niagara County alone, the state looks askance at this prospect.

And finally, Gibbs claims, the state designed a flawed questionnaire, collected information badly, and interpreted the data poorly.

"If that study were to go out into a scientific forum, it would be ripped apart," she says. It wasn't exactly "ripped apart," but it was recently rejected by *Science* magazine for, in part, not identifying which of the two control groups it used was more appropriate for comparison with the exposed population.

Health studies went into abeyance until May 1980 when a "leaked" story appeared on the television evening news, announcing the unconfirmed results of an uncontrolled "study." The study, conducted for EPA by Dante Picciano, scientific director of Biogenics Inc., a small Houston firm, found broken or extra chromosomal (genetic) material in 11 of 36 residents, which it linked to chemical exposure, and which it said foreshadowed miscarriages, cancers, and other disorders.

Preposterous though it may seem, an attempt was made to gloss this limited, uncontrolled study, undertaken to gather legal evidence for EPA's lawsuit against Hooker, with a scientific sheen by having two expert panels review it. These panels assailed the study for lacking controls and for other methodological deficiencies after reviewing, not primary chromosome preparations, but the report itself and photocopies of photographs of these preparations.

Still a third panel of academicians, reviewing the primary material, supported some of Picciano's findings and called for an expanded, controlled chromosome study of residents.

Paigen selected the 36 residents for the chromosome study, and she tells C&EN that she also had controls picked out, but that she and Picciano were rebuffed by EPA on this issue.

Paigen also was involved in another study that surfaced with the chromosome test. This one, designed and conducted by Stephen Barron, assistant professor of neurology at the State University of New York, Buffalo, charted the conduction of the nervous impulse along peripheral nerves in 35 residents presumably exposed to the neurotoxins found at Love Canal, and in 20 control subjects.

Barron, a neurologist not a statistician, at first thought his data showed a slowing of conduction in exposed residents. At the request of EPA, he submitted his data to rigorous statistical analyses, and in the process "the difference in the mean nerve impulse velocities of residents vs. controls lost power, but the direction of change was still there: a

slowing of nerve conduction in Love Canal residents," Barron explained.

The velocity of conduction is a sensitive indicator of neurological damage, appearing long before such overt symptoms as tingling and numbness occur. Nerve conduction, therefore, may be an excellent biological marker for toxic exposure. Barron is encouraged enough by his findings to seek funds for a larger study from EPA and private foundations.

Although Barron's preliminary nerve study was not statistically significant, but nonetheless "meaningful," and Picciano's limited study of chromosomes was widely criticized as no better than a legal fishing expedition, they became the scientific veneer to the federal government's decision to declare—for the second time in two years—a state of emergency at Love Canal. The government had little choice. The incredibly poor manner in which the chromosome data were handled raised the already high level of fear and hysteria still higher. This fear was little quelled by the government's insistence on temporary relocation of the 710 affected families, so chosen because they lived in the tax abatement area created by the state legislature to encourage people to remain in the area.

On May 21, the day the emergency declaration was announced, Gov. Carey called Love Canal a "neighborhood of fear" and said that temporary removal was not sufficient to alleviate "the disruption of their lives and the continued trauma." He called on the federal government to match the state's efforts by purchasing the homes that are now "presumed to be contaminated."

As the tug-of-war between the state and the federal government continues, the parade of health studies marches on. In June, the Environmental Defense Fund, with funding from private foundations, began preliminary tests that will chart growth and maturation of children under 18, and nerve conduction in children and adults. Joseph Highland, head of the environmental group's toxic chemicals program, is spearheading this effort. Paigen is an unpaid consultant on both studies, and Barron will conduct the nerve studies.

The rationale behind both studies is that simple, noninvasive, biological markers of health effects related to toxic chemical exposure exist. Growth and maturation and nerve conduction may be such markers.

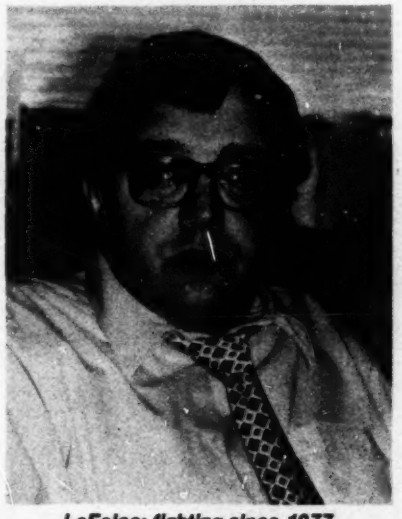
Growth and development are retarded in animals exposed to toxic chemicals; children also may be so affected. The preliminary study, which the scientists feel is adequately controlled, will test this hypothesis. Because it wasn't a government-sponsored study, resident participation, including children who already had moved from the area, was high—about 60 to 70%. The collected growth data are now being analyzed, and the nerve-conduction tests are just getting under way.

Highland has submitted a proposal to EPA for funding to expand the growth and nerve conduction studies. His proposal, though well received, has not yet been funded by the agency. However, he recently received $50,000 from the Frank S. Gannett Newspaper Foundation to support these efforts.

The immediacy of testing and the high rate of participation may give added weight to Highland's preliminary (and now expanded) efforts, especially if CDC's studies are delayed further and permanent relocation begun, which will scatter still more residents and lower the participation rate.

CDC's studies, which were to begin the first week in August, originally were to be conducted by EPA. Sometime between the emergency order of May 21 and early June, the responsibility for health testing shifted to CDC. The order came from the White House, possibly in response to EPA's poor handling of the chromosome study, possibly because the Office of Management & Budget and the Office of Science & Technology Policy believe that "no program to establish an emergency capability in health effects should be developed by EPA," or possibly because New York health commissioner David Axelrod, who, it's said, bears little love for EPA, asked that CDC assume responsibility.

At any rate, three months after the emergency declaration, federal health testing, to be headed by CDC's Clark Heath, has not begun. CDC proposed to begin what it calls its first-level tests—"executive" physical examinations and routine blood tests—on all Love Canal residents Aug. 1. From this larger group, individuals selected at random would be included in the so-called second-level specialized tests, whose results would be compared with two control groups.



LaFalce: fighting since 1977

The second-level tests would scan for toxic effects on chromosomes, nerve conduction, the reproductive system, the immune system, growth and development, and psychological well-being. About 40 subjects for the chromosome study were chosen from 12 families whose homes were the most highly contaminated by chemicals.

According to CDC's Renate Kimbrough, physical examinations were to have been completed by the end of the year, and the specialized tests were to have been completed but not analyzed by December. This schedule has been thrown out of kilter by the residents' boycott. CDC, attempting to balance immediacy against sound methodology, wants to select subjects for its specialized tests. Six community organizations want all residents to participate.

CDC claims that there is not enough money or laboratory resources to test all residents for chromosome damage, to take just one example. Furthermore, Heath claims that though the residents are concerned about their health, their more immediate concerns are "relocation, and economic dislocation and attendant uncertainties." But, he says, "the health studies shouldn't be looked upon as a source of any useful data in the near future for deciding the relocation issue."

Disregarding the relocation issue, Heath admits that chemical toxicology, an embryonic science, places a constraint on the types of studies that now can be devised to show a cause and effect relationship between exposure to toxic chemicals and disease.

Heath says: "It is a difficult problem to say a low-level exposure to this or that chemical, let alone to these chemicals in combination, does or does not cause illness. Most of the chemicals cited at Love Canal appear to be at low levels. We know from traditional acute toxicological principles that these aren't the kinds of levels one would expect to produce outright acute toxicity. But the concerns here deal with unknown and rare effects. That, plus the fact that we are dealing with chemicals acting in combinations that have never been

tested, makes it difficult to predict even which effects should be looked for."

CDC's tests, if they are ever begun, are not likely to prove or disprove a causal connection between exposure to chemical contamination and disease among the residents of Love Canal. Because of the time lapse—two years for the families removed from chemical contamination in August 1978—probably the only valid study that now can be conducted, says Paigen, "is a registry of all current and former residents of Love Canal with health followups over the years."

Despite the problems, in 1978 and 1979 the state health department made a considerable effort to "determine the chemical risks faced by the 2618 people who then lived in the Love Canal neighborhood." From its own statistics: It drew 4386 blood samples from 3919 people (some controls) and conducted 114,036 separate blood tests; it conducted 11,138 field interviews with Love Canal and surrounding area residents; it is searching for and conducting health followups on some 2000 people who once lived in the area but moved before 1978; and it conducted 411 physical examinations of workers who performed remedial construction work at the landfill.

From the health and environmental data it has amassed, the state health department concludes that:

- There is an excessive rate of miscarriages and low-birth-weight babies and, possibly, congenital birth defects in certain sections of the Love Canal area, although these cannot be related to chemical exposure.
- There is no evidence for an excess of liver and kidney abnormalities, leukemia, and other blood diseases.
- Cancer rates are within normal limits for this population.
- Computer analysis of the epidemiological survey produces no evidence of "unusual patterns of illness."

In summary, the health department has not been able to correlate the "geographic distributions of adverse pregnancy outcomes" with evidence of chemical exposure. "At present, there is no direct evidence of a cause-effect relationship with chemicals from the canal." The caveat, of course, is that there still might be a cause and effect relationship that has not yet been identified.

Because of the implications to future waste-related environmental health problems, the search for a causal nexus has been intense and continuous. Paralleling its health effects surveys, the state health department has launched a massive environmental monitoring and analysis effort including 5924 soil samples from more than 650 homes and the landfill, of which 2500 have been analyzed, and more than 700 air, sump, and water samples and analyses.

More than 400 separate chemicals have been identified by the state and EPA, including the 2,3,7,8-isomer of dioxin—one of the most potent toxins known to man. This finding was not unexpected. Hooker disposed of trichlorophenol at the canal, and dioxin is the unintentional contaminant of trichlorophenol. But what is alarming is where it was detected: in a composite of surface landfill soil at 5.3 ppb; in a subsurface soil sample taken from the backyard of a 97th St. home abutting the canal at 6.7 ppb; in sediment samples from Black Creek, which flows into the Niagara River, at 30 ppb; and in a composite sample of crayfish taken from Black Creek at 3.1 ppb.

According to health commissioner Axelrod, the state's environmental sampling program confirmed the presence of a "host of toxic chemicals in the landfill"; documented the outward migration of some of these chemicals, "principally through porous topsoil and drainage pipes"; and confirmed "diminishing degrees of soil and air contamination as one moves further away from the landfill." EPA's studies generally confirm the state findings.

The environmental data served, in part, as the basis for the state's August 1978 emergency declaration which, among other things, ordered the Niagara County Board of Health and the city of Niagara Falls to take remedial action to abate the pollution and halt its spread. As a result of this order, the city contracted with the Canadian firm of Conestoga-Rovers & Associates to install a tile drainage system about 40 feet beyond the landfill but paralleling its full length on both sides, and to place a sloping clay cap completely over the landfill.

The drainage system, completed in December 1979, now collects precipitation runoff and canal leachate, which are delivered to an on-site filtration plant that removes 99% of the toxic organic chemicals. The treated water is discharged to sanitary sewers that flow to the city's water treatment plant. The effectiveness of this remedial action in stemming the lateral outward flow of chemicals from the canal will be determined by EPA if it is permitted to carry out its proposed environmental studies.

According to state geologists who made hundreds of borings around the landfill during the construction of the leachate collection system, the soil strata of the landfill are fairly well defined. From ground level to about 5 feet below grade, the soil is sand and silt—a permeable layer that allows leachate from the canal to pass easily. Below this layer to a depth of about 25 feet are lacustrine clays, which are very impermeable. Below this layer, to a depth of 40 feet, is glacial till, a highly impermeable layer; and below the glacial till is limestone bedrock.

The geologists don't know the exact depth to which the canal was excavated, but seismic surveys over its central and northern portions suggest that the excavation was 12 to 13 feet deep. The excavated depth of the southern section is not known and, therefore, the thickness of the protective clay layer between buried chemicals and bedrock is not known. Hooker did most of its dumping on the southern section of the canal, and the highest levels of contamination and reported illnesses were found in homes abutting this portion.

Still, Frank Rovers of Conestoga-Rovers supports Hooker's contention that the nature of the soils at Love Canal made it an ideal burial vault for chemicals. He asserts that "the hydrogeological environment of Love Canal would allow for adequate design of a secure disposal facility," even under today's more stringent Resource Conservation & Recovery Act regulations. The problems at Love Canal, he says, resulted from a failure to monitor and maintain the site after closure, and from disruption of the closure by subsequent construction.

The courts, of course, will decide who was liable for monitoring and maintenance: Hooker, which no longer owned the land, but which knew the nature of the chemicals it buried there, and had the expertise to

Hooker disposed of 21,800 tons of chemicals

Type of waste	Estimated tonnage
Miscellaneous acid chlorides	400
Thionyl chloride	500
Miscellaneous chlorinations	1,000
Dodecyl mercaptans (DDM)	2,400
Trichlorophenol (TCP)	200
Benzoyl chloride	800
Metal chlorides	400
Liquid disulfides (LDS/ MCT)	700
Hexachlorocyclohexane (BHC, Lindane)	6,900
Chlorobenzenes	2,000
Benzyl chlorides	2,400
Sulfides	2,100
Miscellaneous 10% of above	2,000
TOTAL	21,800

monitor and analyze for migrating chemicals; or the board of education and the city of Niagara Falls, which owned the land and developed it, but which might not have fully comprehended the nature of the chemicals disposed by Hooker, nor had the expertise and perhaps even the understanding to acquire outside expertise to monitor the site. Or the courts may find all liable.

Hooker claims that it placed a clay cover over the northern and southern ends of the landfill (it never used the central portion for dumping) when it closed it, and that disruption of this cover by road building, other construction, and removal of the dirt itself broke the integrity of its closure. In its lawsuit against Hooker, the Justice Department claims that the company "did not place an adequate clay cap or other appropriate seal on the canal."

No public documents have yet surfaced to support Hooker's claim of a clay cover, although Hooker may have such documents, which it will bring out in court. However, Frank Ventry, an operating engineer for the city of Niagara Falls who worked at the landfill site after Hooker deeded it to the school board, tells C&EN that it was the city that covered to grade the full length of the canal, including the two ends that Hooker claims to have covered. He says this was done mostly by backfilling from the mounds of dirt piled on the banks of the canal from the original excavation. This point will be argued in court because it bears on the question of whether Hooker properly secured the landfill before it turned it over to the school board.

Although the canal has been deemed an exceptionally fit site for hazardous waste disposal by Hooker and Rovers, there are some natural geologic formations such as swales—dried up streambeds—and a sand lens—a thin layer of sand interspersed between more impervious clay layers—that may have served as preferential routes of migration for the chemicals.

It is not reasonable to assume that Hooker or any company dumping in a landfill in the 1940's and 1950's would have been aware of such geologic formations, but it might be reasonable to assume that diligent, continuous monitoring would have picked up wayward chemical migrations via these formations. The courts will consider the monitoring issue, especially who can be held liable for the lack of monitoring.

Certainly, one of the major routes of chemical migration was, to use Hooker's analogy, the overfilled bathtub. That is, the rising water table in the clay bathtub carried leachate upward and laterally outward through the more permeable top 5 feet of soil.

Gibbs: leading the home owners

But there were two other manmade conduits, according to the Love Canal Homeowners Association consultant, Stephen Lester, that were unearthed during remedial construction in 1978–79. One was a French drain, put in by the school board, that completely encircled the 99th St. school. The drain funneled water and chemical leachate away from the school to storm sewers on 99th St. whose contents flow to the Niagara River, south of the canal. Another was an illegal catch basin put in by a home owner on 97th St. that carried water and leachate to storm sewers on 97th St. whose contents eventually end up in Black Creek, north of the canal. An internal EPA memorandum notes that chemicals buried at Love Canal, including dioxin, have been found in the sediments and water of Black Creek and the Niagara River. The storm sewers may be how the chemicals got to the creek.

Whether chemicals have migrated vertically downward through bedrock to underground aquifers has not yet been established. The state Department of Environmental Conservation sunk three wells to bedrock around the canal, sampled from these twice, and found no organic chemical contamination of the water. But the number of wells is too small to be able to rule out contamination. Therefore, the agency is now sinking seven to 10 additional wells around the canal, and EPA—if it is permitted—will sink from 100 to 200 monitoring wells in a grid pattern around the canal and throughout the community.

Some of EPA's wells will go to bedrock to monitor for aquifer contamination and to determine the hydraulic flow in the area. As planned, the wells will determine the efficacy of the remedial construction effort and map the present flow of chemicals through the community. Knowing the hydraulic flow pattern will be important in closing the gap in the federal government's argument that chemicals buried in the canal have contaminated Black Creek, which flows into the Niagara River.

The state environmental efforts essentially have wound down, although efforts such as groundwater sampling from deep wells will continue. So also will Stephen Kim's efforts to analyze for the first time the 6000 soil samples collected a year ago, and to reanalyze blood samples taken in 1978 and 1979.

This month, a major environmental monitoring effort will be launched by EPA if the residents permit it. The effort will include collection and analyses of a massive amount of indoor and ambient air samples, soil, groundwater, surface water and sediments, drinking water, and sump water samples. EPA's Thomas Hauser is overseeing the $5.4 million integrated assessment project, which is being managed at Love Canal by GCA Corp. of Bedford, Mass. The effort is expected to be completed in six months, at which time EPA will be able to estimate the risk to residents of living near the landfill. In six months, however, that estimate may be moot. By then a political decision already may have been made to move the residents out.

The Love Canal incident has always been a saga played out in the political rather than the scientific arena. Even its explosive inception was not ignited by adequate science, Hooker's president Donald L. Baeder says. According to Baeder, it was then-health commissioner Robert P. Whalen's Aug. 2, 1978, declaration of a state of emergency at Love Canal that "created a spark and a fear in these people that blew up to be the Love Canal that we now know today."

A temporary evacuation order was directed only to those families with pregnant women or children under two living on 97th or 99th Streets—slightly more than 20 families. However, several days later, Gov. Carey expanded the evacuation to include all families living on those two streets, and he made the move permanent by pledging to purchase their homes.

At that time the state had health questionnaires that focused on pregnancy outcomes, analyses of soil samples taken from the canal itself, and analyses of basement air samples

EPA accumulates environmental data for lawsuit against Hooker

Source	Data collected	Chemicals detected	Comment
Water from storm sewers at three locations	August 1978	Hexachlorocyclohexane (1.4–50 ppb), trichlorophenol (0.1–11.3 ppb), chlorobenzene (0.3–0.4 ppb), tetrachlorobenzene (18–130 ppb), & others	Exceed EPA's water quality criteria for human exposure
Sediment samples from 10 locations in Black Creek, Bergholtz Creek, Cayuga Creek, Little River, Niagara River	Sept. 1978	Benzene (0.1–1.7 ppb), hexachlorocyclohexane (31–1200 ppb), trichlorophenols (0.5–90 ppb), chlorobenzene (0.4–2.9 ppb), tetrachlorobenzene (24–240 ppb)	Exceed EPA's water quality criteria for human exposure. Chemicals also found upstream but at substantially lower levels
Drinking water from home taps	Sept. 1978	Chloroform (25 ppb), bromodichloromethane (6 ppb), tetrachlorobenzene (2 ppb)	No concurrent sampling done at drinking water plant, so precise source of chemicals not determined; may have resulted from water treatment
Ambient & basement air	Sept. 1978	Benzene, tetrachloroethylene, trichloroethylene, dichlorobenzene in the moderate-ppb range	The incremental cancer risk was calculated as 1 in 100 to 1 in 1000 for some of the homes tested
Leachate from leachate collection system (southern section)	June 1979	Lindane (γBHC) (160 ppb), dichlorobenzenes (7200 ppb), & others	
Leachate from French drain system around 99th St. School	June 1979	Lindane and dichlorobenzenes & others at one-tenth concentration of the same chemicals found in landfill leachate system	
Surface water & home sump pumps (northern section)	June 1979	Phenol (0.4–4.7 ppb), pentachlorophenol (54–70 ppb), trifluoro *m*-cresol (12–102 ppb), [trichlorobenzene (1030 ppb), hexachlorobenzene (250 ppb) found in sumps only]	Exceed water quality criteria for human exposure
Ambient & basement air	Nov. 1979	Light to moderate contamination of a number of chemicals, including benzene	Only 2 homes sampled; location not listed; 1 in 10,000 additional risk of cancer

of the homes bordering the canal collected by EPA and the state. All told, the state found some 82 compounds in the soil, and seven compounds in the air that induce cancer in animals, including benzene, which is a known human carcinogen. From the epidemiologic survey, the state found a 1.5 times greater than expected normal risk for spontaneous abortion. These findings led to the emergency declaration, which Baeder contends was based on "inadequate and incomplete studies."

For instance, Baeder argues, "the concentration of chemicals that were detected in the basements . . . were not compared with any controls, nor were they compared with . . . Occupational Safety & Health Administration standards on allowable limits for these chemicals in a continuous working environment." Nothing was done by Whalen, Baeder says, "to try to put these into perspective as to the levels of exposure, and the risk associated with those levels." Furthermore, Whalen failed to have the epidemiologic data reviewed by competent, independent experts.

The levels of chemicals measured in the basements of the homes, Baeder says, were in many cases "a small fraction of a per cent of what OSHA would permit for a continuous working environment. So if you want our position on the relative risk of exposure to chemicals found, it would be extremely small." Baeder goes as far as to say that the "level of exposure from all of the measurements that have been made at Love Canal precludes these chemicals at the detected level from having an effect on the health of those people. Now, that does not mean that those people aren't suffering from asthma, cancer, leukemia, any other abnormalities they claim. But what the state says is that those disease rates are normal for that population."

But the state, in the person of Stephen Kim, the scientist who analyzed those 1978 samples and who is now director of the state's Toxicology Institute, says: "The primary motivation for Whalen's action was the contamination on the surface of the landfill," to which the residents had open access, not the indoor air samples. "The highest risk was the kind of exposure—body burden—that a child might get playing on the surface of the canal, then eating without washing his or her hands."

Further, Kim says, the state had solid and very compelling evidence for Whalen's order, environmental and epidemiologic evidence that was reviewed by a blue-ribbon panel of government, industry, and academic scientists.

Addressing the indoor air levels, Kim says that OSHA standards—those that the agency has in the form of threshold limit values—are inappropriate guidelines for indoor household air levels, because they are set for a healthy working population, generally male, exposed for only a part of a 24-hour day, five days a week, with a two-day respite of nonexposure. "It's not continuous exposure," Kim argues, "so we don't think it's necessarily appropriate for protecting susceptible segments of the population—the very elderly, sick people, the fetus, and developing children," who may be exposed on a more continuous basis in the home.

In addition, the homes that were contaminated with chemicals usually contained a mixture of compounds that could act in an antagonistic fashion or in a synergistic manner. If the action was synergistic, and no one knows that it was, induced health effects would be greatly enhanced, notes EPA's Hauser.

In short, Kim answers Baeder's charges by saying that internal and external controls were available to him, cancer risk assessments were calculated and have been made public, and the epidemiologic findings as well as the environmental data were reviewed by outside experts before Whalen made his announcement.

The variation of the data, which correspond to certain geologic features, acted as internal controls. External controls included some data from basements in downtown Niagara Falls and the investigators' own homes in Albany, N.Y. Kim also says he attempted to eliminate confounding variables such as chemicals found in consumer products and auto exhaust fumes by using marker chemicals such as chlorotoluene and chlorobenzene, not found in consumer products. These latter chemicals were found in some of the homes and therefore could be expected to have emanated from chemicals buried in the canal, not from normal consumer products.

Still Baeder insists: "The facts are, and the state has so stated, that there is really no evidence to connect the chemicals of Love Canal with the ill effects that are reported by the residents. No information on that." Kim agrees in part. "Of the chemical indicators that we have measured so far," he says, "there is not a statistically significant correlation between those and the health effects that we have studied so far. But that does not mean that such a relationship will not be found, it only means we haven't found it yet.

"Love Canal is an important landmark in environmental health; finding a cause and effect relationship in this type of situation has never been done before. But our effort is continuing intensively," Kim says.

There is no question that society is on a learning curve with respect to environmental health issues. There also is no question that chemical-analytical probes are more advanced than medical probes. But all that is moot.

Love Canal, because of an incredible series of events, has moved beyond the scientific pale: Decisions affecting people's lives and corporate actions are being based on political expediency and liability law. However, if the Love Canal saga is allowed to play out, it may extend the frontiers of corporate responsibility as well as those of law and environmental health science.

At the moment, Hooker has chosen to follow a more legalistic path. Other companies might have responded differently. But the problem a corporation faces today, says Robert Roland, president of the Chemical Manufacturers Association, is "when and under what circumstances does [it] respond to the equities of a situation vs. the legalities of a situation. When does the equity concern of what you think is the correct thing to do take precedence over the legal concern?" It's a difficult balancing act to maintain, Roland admits. And there's no denying that on the question of equity, "there has been a definite change in mindset" in the past few years, Roland says.

He elaborates: "A decision made in 1980 would by necessity be different from a decision that was made in 1975. I think that enough has happened during that period to alter the response that a company would give to a Love Canal-type situation. The legal concerns—personal liability, environmental damage, all of the rest—are no less grave today than they were then, but the recognition of the terribly adverse impact that the media can have, that inappropriate governmental response can have, that human expectations can have on such a problem, demand a response that may be less legalistic and more humanistic."

Hooker essentially took a legalistic stance. Baeder says, "I believe that the company was very responsible in the way it handled those chemicals, in the closing of the canal, in the transference to the city for the use intended, and in warnings to the school board when we were appraised of situations [proposed land development]."

The federal government and the state of New York apparently disagree. The Justice Department in December 1979 filed a $45 million suit against Hooker for waste disposal at Love Canal, part of a $124.5 million suit against the company for hazardous waste disposal at four dump sites in Niagara Falls. New York state in April 1980 filed a $635 million suit against Hooker. Both suits seek damages for the consequences of the dumping of hazardous wastes at Love Canal. Hooker has answered only the federal complaint, denying liability.

Should the federal claim go to trial, two prime issues will be litigated: adequate warning and ultrahazardous activity. The concept of ultrahazardous activity is well established, but not for cases involving the disposal of toxic materials. If the court deems the disposal of toxic wastes an ultrahazardous activity and imposes the excessive duty of care and responsibility on Hooker that has been established for other activities deemed ultrahazardous, then the limits of liability law will have been enlarged.

The federal complaint states that Hooker did not give adequate warning. Barry Trilling, the Justice lawyer handling the case, says: "Hooker had knowledge of what was in the site, it had better knowledge than anybody about the dangers and hazards of the chemicals; it had the scientific capacity to know what may or may not happen; and it was in the best position to let people know what the problems were."

That succinct statement may be the government's strongest argument in its suit against Hooker. There is now a flurry of activity at EPA and Justice to gather the preponderance of evidence needed to establish the government's claim.

Whether Hooker chooses, in Trilling's words, to test "the fires of adversary litigation," or settle the suits out of court—which some believe it will do to avoid further adverse publicity attendant to the discovery of evidence during a trial—is a litigation management problem that Hooker will have to resolve.

Certainly, adverse publicity already has hurt the company, even in actions that it has taken that are environmentally "acceptable." For example, this fall, Hooker will begin operating a $94 million energy-from-waste project at its Niagara Falls plant. The project's financing took five years, and the private underwriters admit that the Love Canal incident probably added a half point to the financing cost.

The harsh glare of adverse publicity also has fallen on governmental response to the challenges of Love Canal. Bureaucratic bungling, interagency haggling, and bows to political expediency that in part have characterized this response have been spotlighted in the press.

Before the most severely exposed residents moved away and before remedial measures were taken to stem the tide of migrating chemicals, well-designed and -executed monitoring studies might have served as the basis for sound policy decisions on future Love Canal-type incidents. But the passage of time makes a cause and effect relationship more difficult to discern. The body heals and the environment cleanses itself.

Now the best that can be salvaged from the planned federal effort is the beginning of a record chronicling the possible health effects on residents exposed to long-term, low levels of a mixture of toxic chemicals. The proposed studies cannot and will not satisfy the residents' desire to know their future health prospects, or those of their children. The studies cannot and will not tell women whether they can bear healthy children. Nor will the studies yield enough information on which decision makers can set good public policy in the near future. But they will be a beginning.

The pity of Love Canal is that so many lives have been so badly disrupted, and an unfortunate but exceptional opportunity to expand our knowledge of chemical toxicity has been frittered away. □